

CLAIMS

1. An apparatus for producing carbonated water, comprising:

carbon dioxide gas supplying means;

water supplying means and/or water circulating means;

a first carbon dioxide gas dissolver connected to the carbon dioxide gas supplying means and the water supplying means and/or the water circulating means; and

a second carbon dioxide gas dissolver connected to a carbonated water discharging side of the carbon dioxide gas dissolver.

2. The apparatus for producing carbonated water according to claim 1, wherein the carbon dioxide gas supplying means is connected to only the first carbon dioxide gas dissolver.

3. The apparatus for producing carbonated water according to claim 1 or 2, wherein the first carbon dioxide gas dissolver includes a membrane module.

4. The apparatus for producing carbonated water according to claim 3, wherein the membrane module includes a hollow fiber membrane.

5. The apparatus for producing carbonated water according to claim 4, wherein the hollow fiber membrane is a three-layer composite hollow fiber membrane in which both faces of a thin non-porous gas permeation layer are sandwiched by porous layers.

6. The apparatus for producing carbonated water according to any one of claims 1 to 5, wherein the second carbon dioxide gas dissolver includes a static mixer.

7. The apparatus for producing carbonated water according to claim 6, wherein the static mixer is a stator type and/or a Kenics type.

8. The apparatus for producing carbonated water according to claim 6 or 7, wherein a number of elements in the static mixer is 5 to 100.

9. The apparatus for producing carbonated water according to any one of claims 6 to 8, wherein an element diameter of the static mixer is 5 to 100 mm.

10. The apparatus for producing carbonated water according to any one of claims 1 to 9, wherein carbon dioxide gas flow rate control means is disposed in a downstream of the carbon dioxide gas supplying means and in an upstream of the first carbon dioxide gas dissolver.

11. The apparatus for producing carbonated water according to any one of claims 1 to 10, wherein water flow rate control means is disposed in an upstream of the first carbon dioxide gas dissolver.

12. The apparatus for producing carbonated water according to any one of claims 1 to 11, wherein a pressure increasing pump is disposed in an upstream of the first carbon dioxide gas dissolver.

13. The apparatus for producing carbonated water according to claim 12, wherein a start/stop flow switch of the pressure increasing pump is disposed in a line of the carbonated water producing apparatus, through which water or carbonated water passes.

14. The apparatus for producing carbonated water according to any one of claims 1 to 13, wherein a liquid-vapor separator for separating carbonated water and non-dissolved carbon dioxide gas is disposed in a downstream of the second carbon dioxide gas dissolver.

15. The apparatus for producing carbonated water according to claim 14, wherein a bubble sensor is disposed in the downstream of the liquid-vapor separator.

16. The apparatus for producing carbonated water according to claim 15, wherein the bubble sensor is of ultrasonic type.

17. The apparatus for producing carbonated water according to any one of claims 1 to 16, further comprising a carbon dioxide gas concentration sensor and/or an oxygen concentration sensor.

18. A method for producing carbonated water comprising steps of: supplying water and carbon dioxide gas to a first carbon dioxide gas dissolver; and supplying obtained carbonated water to a second carbon dioxide gas dissolver.

19. The method for producing carbonated water according

to claim 18, wherein water is passed through the first carbon dioxide gas dissolver by single-pass.

20. The method for producing carbonated water according to claim 18, wherein water is circulated through the first carbon dioxide gas dissolver.

21. The method for producing carbonated water according to any one of claims 18 to 20, wherein carbon dioxide gas is supplied to only the first carbon dioxide gas dissolver.

22. The method for producing carbonated water according to any one of claims 18 to 21, wherein the first carbon dioxide gas dissolver includes a membrane module.

23. The method for producing carbonated water according to claim 22, wherein the membrane module contains a hollow fiber membrane.

24. The method for producing carbonated water according to claim 23, wherein the hollow fiber membrane is a three-layer composite hollow fiber membrane in which both faces of a thin non-porous gas permeation layer are sandwiched by porous layers.

25. The method for producing carbonated water according to any one of claims 18 to 24, wherein the second carbon dioxide gas dissolver is comprised of a static mixer.

26. The method for producing carbonated water according to claim 25, wherein the static mixer is a stator type and/or a Kenics type.

27. The method for producing carbonated water according to claim 25 or 26, wherein a number of elements in the static mixer is 5 to 100.

28. The method for producing carbonated water according to any one of claims 25 to 27, wherein an element diameter of the static mixer is 5 to 100 mm.

29. The method for producing carbonated water according to any one of claims 18 to 28, wherein carbon dioxide gas is supplied to the first carbon dioxide gas dissolver at a specified flow rate.

30. The method for producing carbonated water according to any one of claims 18 to 29, wherein water is supplied to the first carbon dioxide gas dissolver at a specified flow rate.

31. The method for producing carbonated water according to any one of claims 18 to 30, wherein a pressure increasing pump is disposed in an upstream of the first carbon dioxide gas dissolver and water pressurized by the pressure increasing pump is supplied to the first carbon dioxide gas dissolver.

32. The method for producing carbonated water according to claim 31, wherein a flow switch is disposed in a line, through which water or carbonated water passes, and the pressure increasing pump is driven only when water or carbonated water exists in the line.

33. The method for producing carbonated water according to any one of claims 18 to 32, wherein a temperature of generated

carbonated water is in a range of 30 to 45°C.

34. The method for producing carbonated water according to any one of claims 18 to 33, wherein concentration of free carbon in generated carbonated water is in a range of 800 to 1500 mg/L.